US009332356B2

(12) **United States Patent**
Finlay

(10) **Patent No.: US 9,332,356 B2**
(45) **Date of Patent: *May 3, 2016**

(54) **HEARING AID**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 336 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/875,529**

(22) Filed: **May 2, 2013**

(65) **Prior Publication Data**

US 2013/0236042 A1 Sep. 12, 2013

Related U.S. Application Data

(63) Continuation of application No. 13/354,834, filed on Jan. 20, 2012, now Pat. No. 8,442,253.

(60) Provisional application No. 61/436,312, filed on Jan. 26, 2011.

(51) **Int. Cl.**
H04R 25/00 (2006.01)
H04R 1/10 (2006.01)

(52) **U.S. Cl.**
CPC ***H04R 25/00*** (2013.01); ***H04R 25/60*** (2013.01); ***H04R 25/608*** (2013.01); ***H04R 25/65*** (2013.01); *H04R 1/1058* (2013.01); *H04R 2225/021* (2013.01); *H04R 2225/025* (2013.01)

(58) **Field of Classification Search**
CPC H04R 25/60; H04R 25/604; H04R 25/608; H04R 25/65; H04R 25/652; H04R 25/656; H04R 2225/021; H04R 2225/023; H04R 2225/025; H04R 2225/63; H04R 2460/09; H04R 1/1058; H04R 1/1075; H04R 25/654
USPC 381/322, 324, 325, 327, 328, 330, 380, 381/381, 382, 384; 379/430; 181/129, 130, 181/135
See application file for complete search history.

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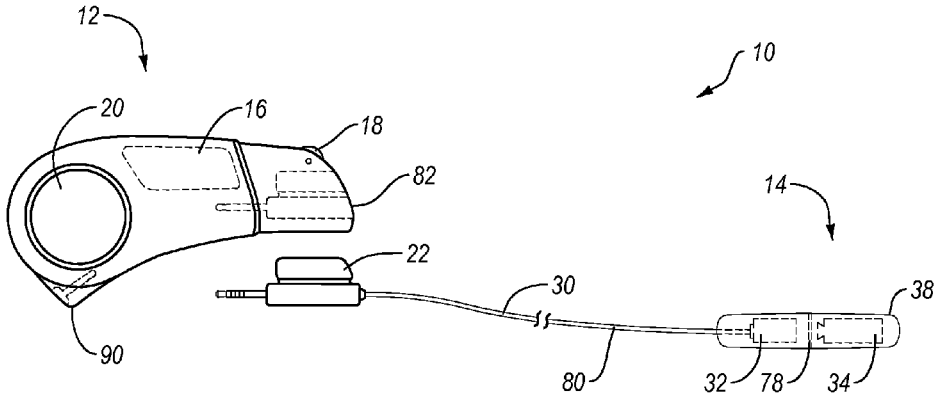
(57) **ABSTRACT**

A hearing aid of the present invention is convenient to repair and replace. The hearing aid includes: (i) an out-of-canal assembly comprising a power source (e.g., a battery) and a processor, and (ii) an in-canal assembly comprising a microphone and a receiver. The out-of-canal assembly is selectively, removably, electrically coupled to the in-canal assembly. Sound perceived by the in-canal assembly is processed by the out-of-canal assembly and transmitted to the user's eardrum. The in-canal assembly is conveniently, selectively decoupled from the out-of-canal assembly for convenient replacement or repair.

20 Claims, 5 Drawing Sheets



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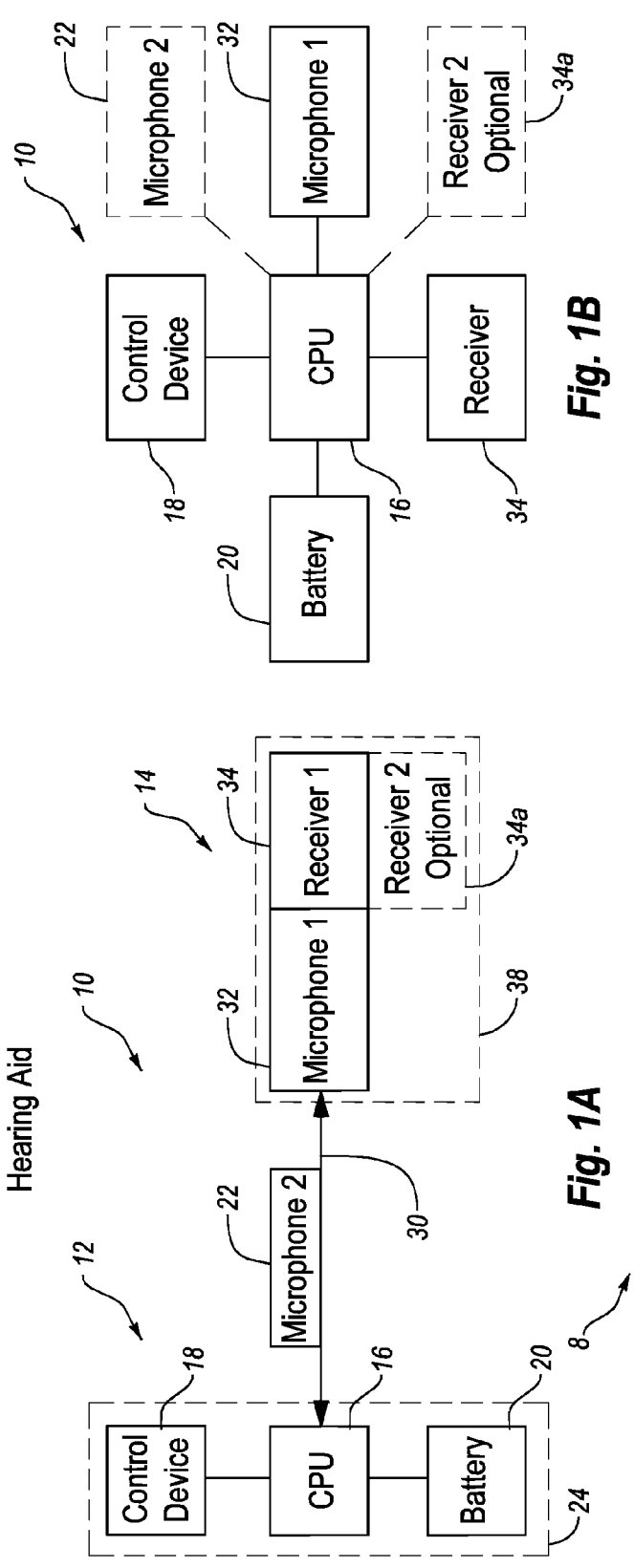

Fig. 1A

Fig. 1B

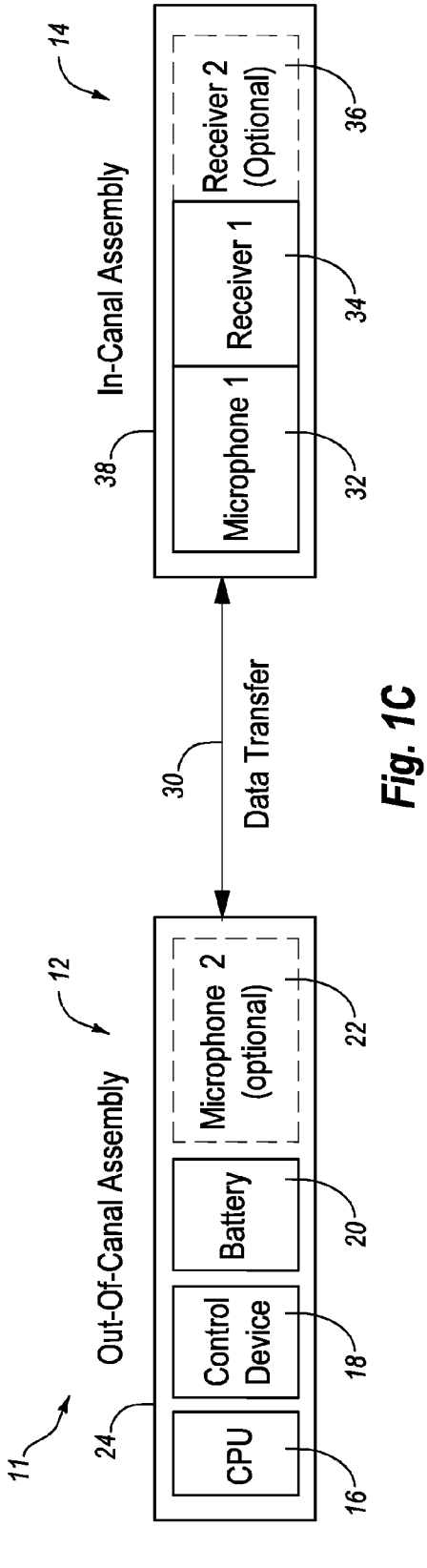

Fig. 1C

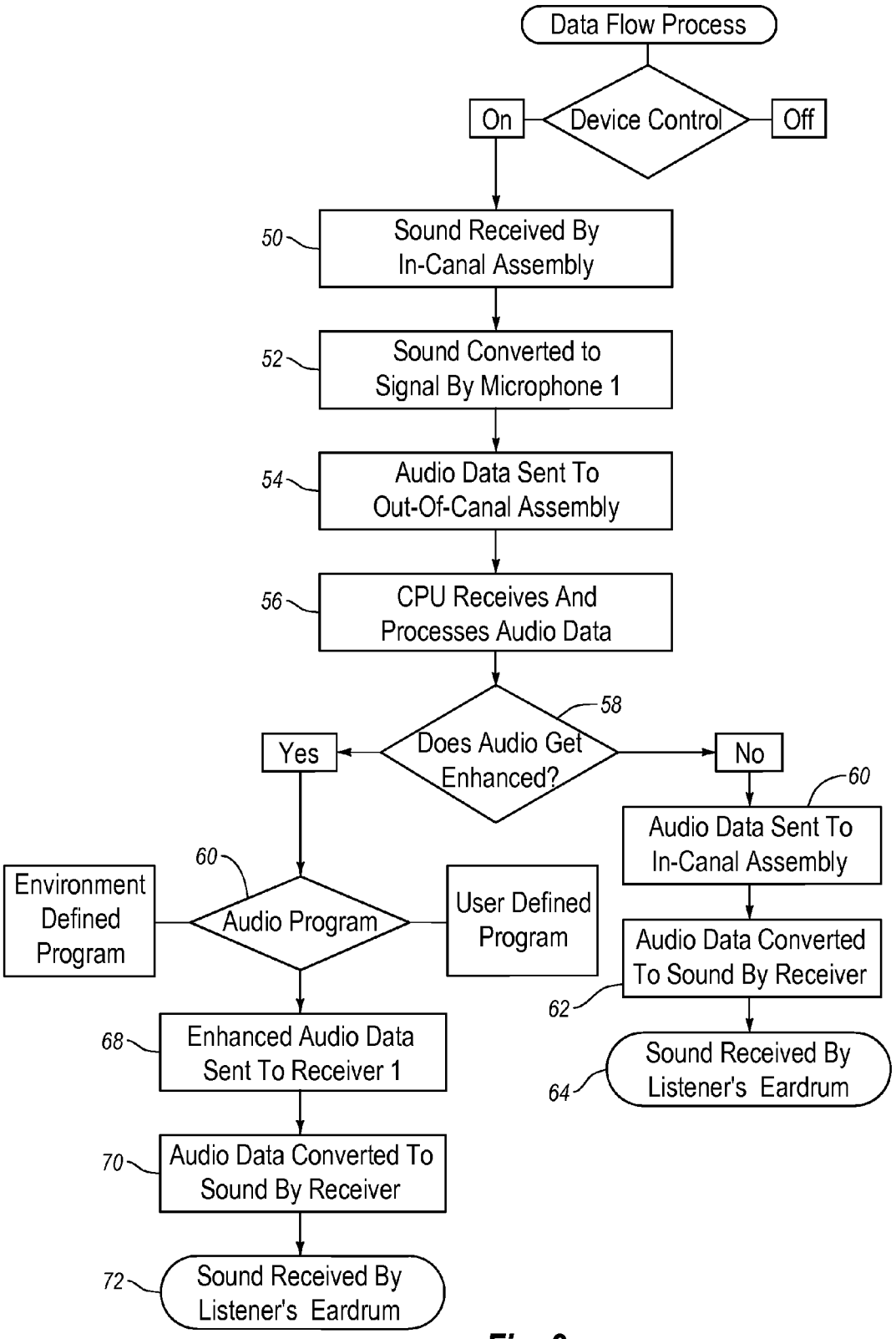
Data Flow Process
On
Device Control
Off
50
Sound Received By In-Canal Assembly
52
Sound Converted to Signal By Microphone 1
54
Audio Data Sent To Out-Of-Canal Assembly
56
CPU Receives And Processes Audio Data
58
Does Audio Get Enhanced?
Yes
No
60
Audio Data Sent To In-Canal Assembly
Audio Data Converted To Sound By Receiver
62
Sound Received By Listener's Eardrum
64
60
Environment Defined Program
Audio Program
User Defined Program
68
Enhanced Audio Data Sent To Receiver 1
70
Audio Data Converted To Sound By Receiver
72
Sound Received By Listener's Eardrum

Fig. 2

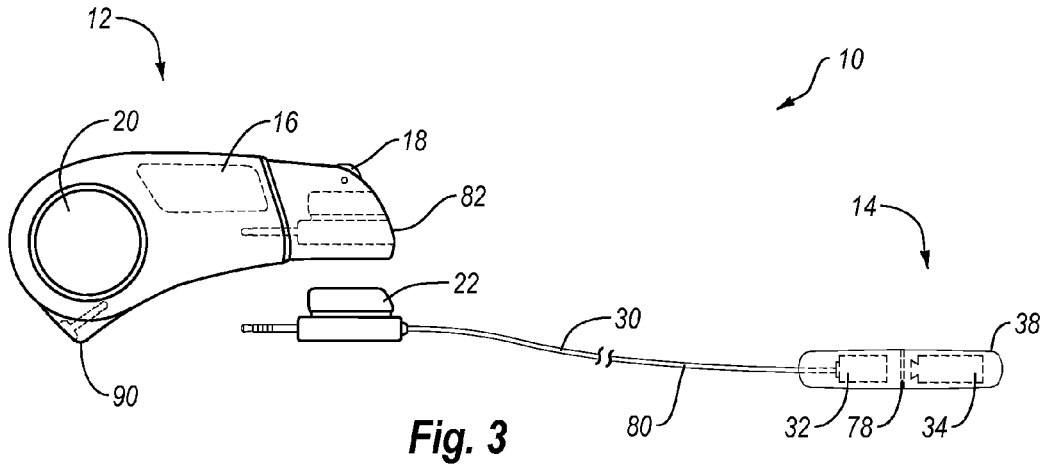

Fig. 3

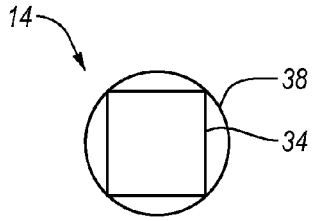

Fig. 3A

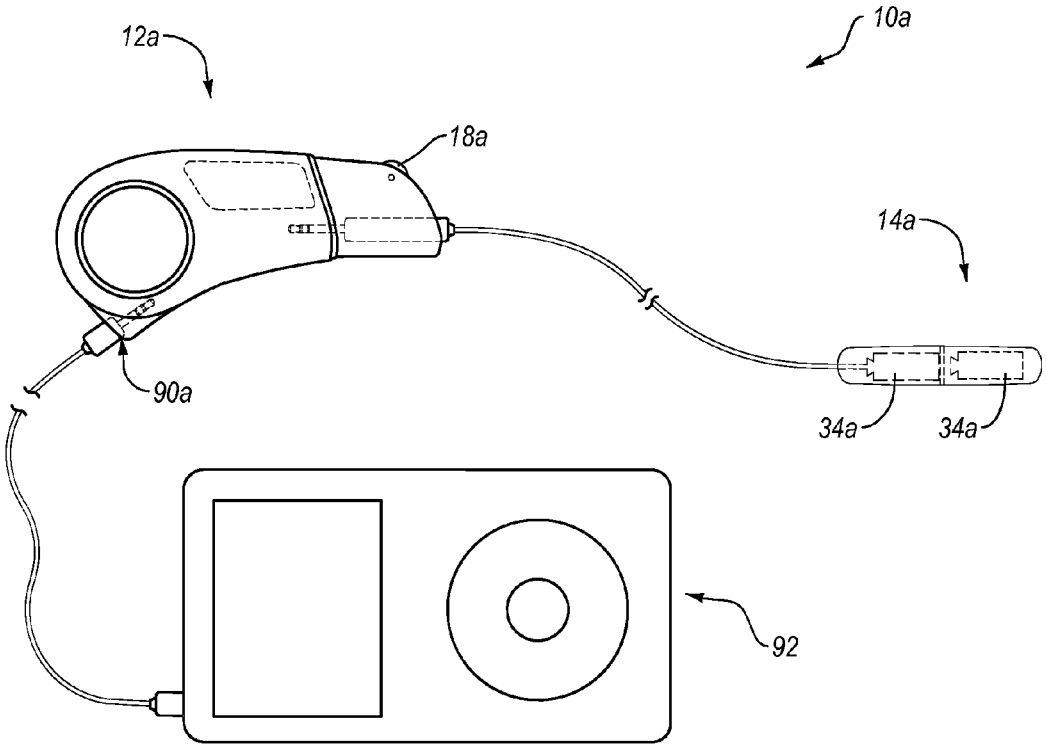

Fig. 4

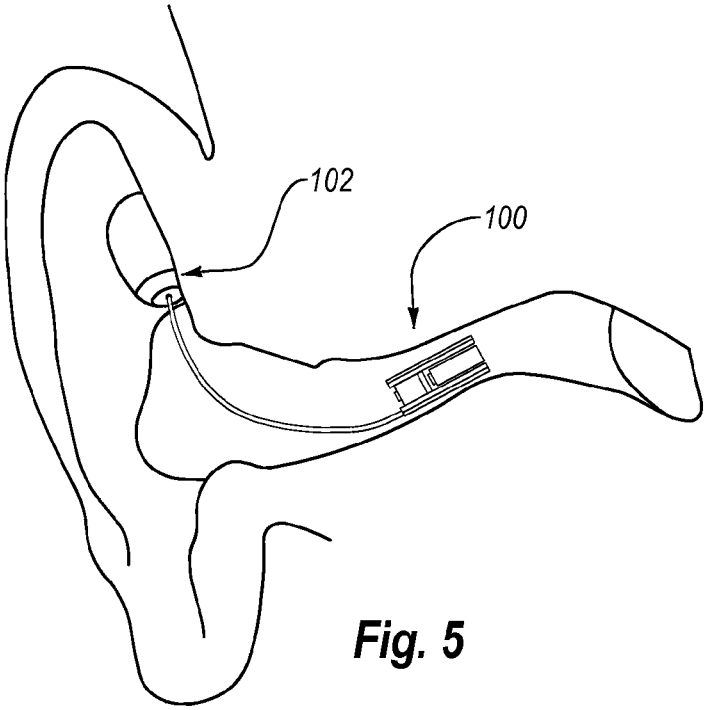

Fig. 5

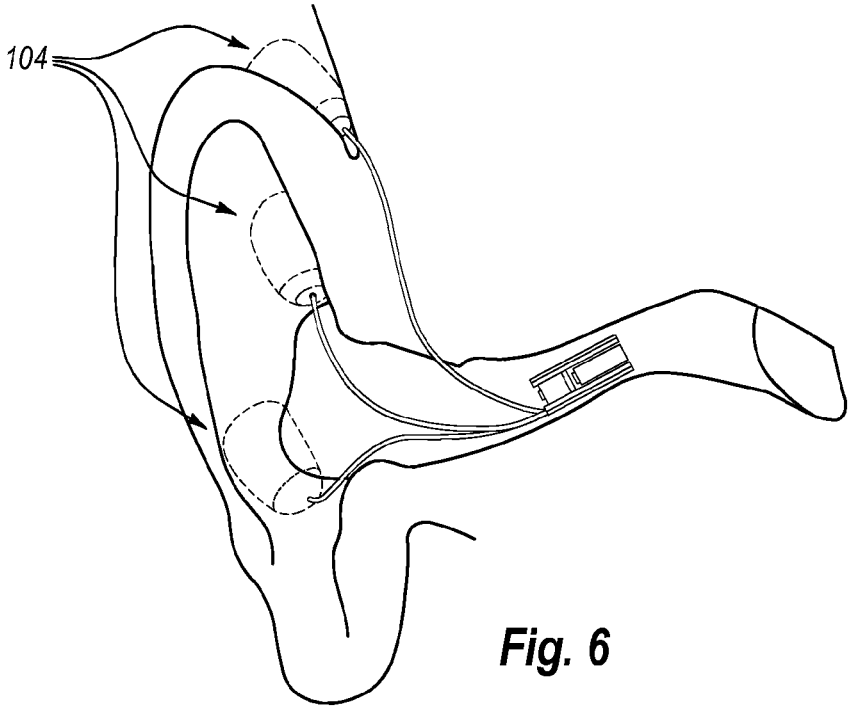

Fig. 6

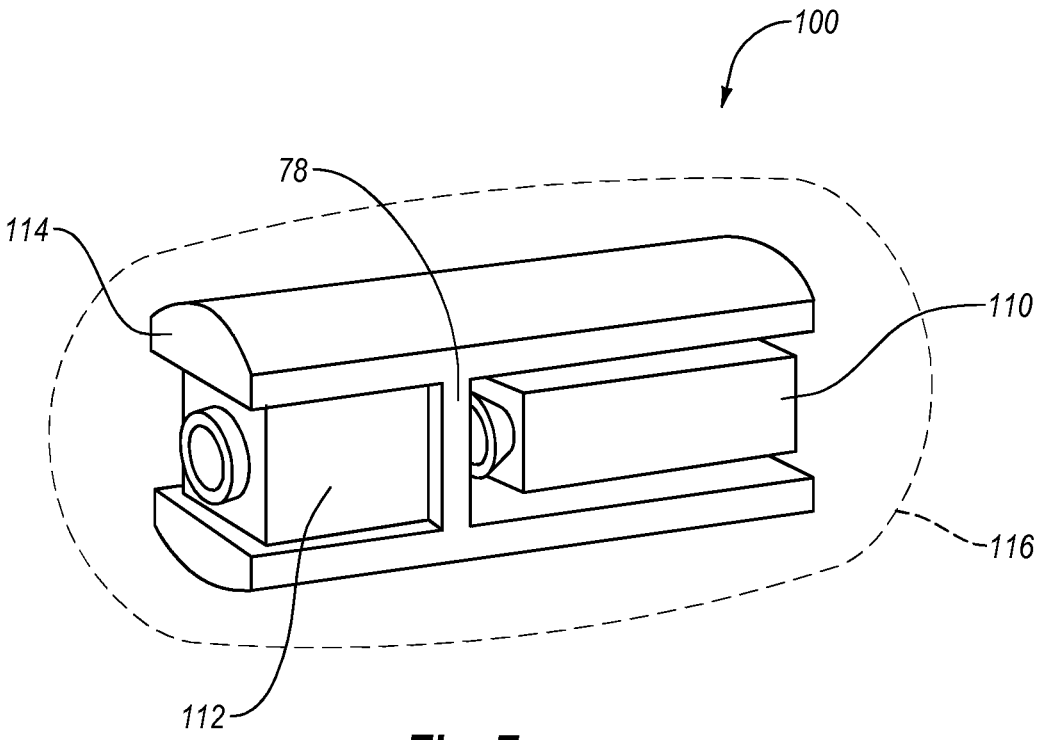

Fig. 7

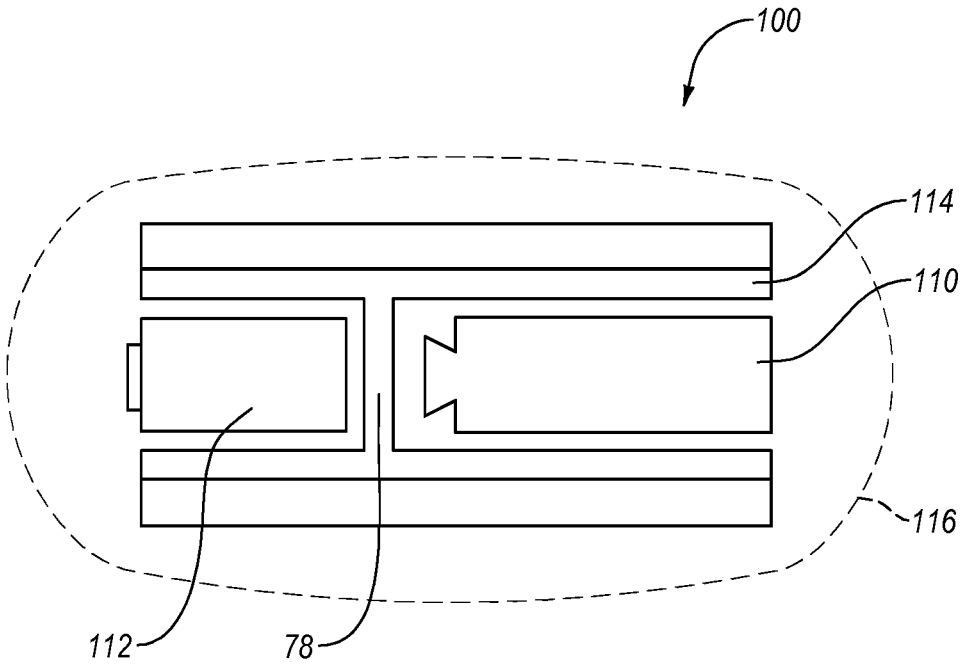

Fig. 8

HEARING AID

RELATED APPLICATION

This non-provisional patent application is a continuation application of U.S. non-provisional patent application No. 13/354,834 entitled Hearing Aid, filed on Jan. 20, 2012, which claims priority to and the benefit of U.S. provisional patent application No. 61/436,312, filed on Jan. 26, 2011, entitled Hearing Aid, each of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. The Field of the Invention

This invention is in the field of hearing aids and other listening devices.

2. The Relevant Technology

Hearing aid devices have become of great assistance to the hearing impaired. For decades, the hearing-impaired have been using electronic hearing aid devices that fit either within the ear canal or partially within the ear canal and partially outside the ear canal. The portion of a hearing device that fits within the ear canal and even the portion of the hearing aid device that is outside the ear canal is typically subject to damage from the environment and from the oils, acids, waxes, and perspiration from a user's body. As a result, it is common to replace parts and to require expensive warranties to maintain typical hearing aids.

What is needed is a hearing aid that is inexpensive to maintain, that has parts that are convenient to repair and replace, and that is inexpensive and convenient for a user to use and manage in daily use.

BRIEF SUMMARY OF THE INVENTION

A hearing aid of the present invention is convenient to repair and replace. The hearing aid comprises: (i) an out-of-canal assembly (i.e., out of ear canal assembly) comprising a power source (e.g., a battery) and a processor, and (ii) an in-canal assembly (i.e., in-ear canal assembly) comprising a microphone and a receiver (i.e., a speaker). The out-of-canal assembly is selectively, removably, electrically coupled to the in-canal assembly. Sound perceived by the in-canal assembly is processed by the out-of-canal assembly and transmitted back to the user's eardrum. The in-canal assembly is conveniently, selectively decoupled from the out-of-canal assembly for convenient replacement or repair.

Since the in-canal assembly is removably, electronically coupled to the out-of-canal assembly, the in-canal assembly is readily replaceable. The ability to replace the in-canal assembly provides many advantages from a technological, economic and convenience standpoint. The in-canal assembly comprises the components, e.g. the receiver and microphone, that are the most commonly subjected to wear, damage, and malfunction due to wax, oils, and fluids associated with the user's ear canal. Openings for the microphone and receiver are present in the in-canal assembly. The out-of-canal assembly, however, can be configured to be sealed so as to prevent fluids and other potential damaging elements from affecting the electrical components of the assembly. By separately connecting the in-canal assembly to the out-of-canal assembly, the user is typically only required to replace the in-canal assembly when any damage occurs.

For example, in one embodiment, a hearing aid is sold with one out-of-canal assembly and with multiple e.g. 2, 3, 4, or 5 in-canal assemblies so that replacement of the in-canal assembly is convenient when damage or wear occurs. This also makes warranty treatment convenient in the event that the in-canal assembly needs to be mailed to an out of town facility for repair or replacement.

The word "receiver," as referred to herein, refers to a speaker that emits sound therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only illustrated embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

FIG. **1**A is a schematic, functional view of a hearing aid of the present invention, the hearing aid comprising (i) an out-of-canal assembly **12**; and (ii) an in-canal assembly **14**.

FIG. **1**B is an example of a possible wiring diagram of the hearing aid of FIG. **1**A. In one embodiment, the communication between the various devices of the present invention is provided in a wireless, e.g., Bluetooth, format as opposed to via a physical wired connection.

FIG. **1**C is another schematic, functional view of an alternative hearing aid of the present invention.

FIG. **2** represents a functional flow diagram that describes the process of sound as it flows from the environment through the hearing aid of FIGS. **1**A-**1**B, for example.

FIG. **3** is a depiction of the hearing aid of FIG. **1**A.

FIG. **3**A is a depiction of a rear view of the in-canal assembly of FIG. **3**, showing the receiver (speaker) surrounded by the housing.

FIG. **4** is a depiction of an alternative hearing aid of the present invention that is employed to assist a user in listening to sound from a consumer electronic device such as a radio, MP3 player, I-POD, or other electronic device that generates sound.

FIG. **5** is a depiction of an alternative hearing aid of the present invention.

FIG. **6** is a depiction of yet another alternative hearing aid of the present invention.

FIG. **7** is a representation of an in-canal assembly of the present invention.

FIG. **8** is a cross sectional view of the in-canal assembly of FIG. **7**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1**A is a functional representation of a hearing aid **10** of the present invention. Hearing aid **10** is comprised of out-of-canal assembly **12** and in-canal assembly **14**, which is electronically coupled to out-of-canal assembly **12**. Out-of-canal assembly **12** is comprised of: (i) a central processing unit **16**, such as an amplifier or other processing device that processes information and data necessary for the functioning of the hearing aid; (ii) a control device **18**, such as a rotatable volume setting device, a series of buttons (or optionally a remote control device or software application on a cell phone, for example); (iii) a power source such as a battery **20** for providing power to the central processing unit **16** and any other components that need electrical power.

Various components of out-of-canal assembly **12** are housed by a housing **24**. Thus, CPU **16**, control device **18**, and

battery **20**, may be housed within or on a housing **24**. Optionally, an alternative control device is located separately from housing **24**, for example, in a remote device, e.g., a remote control, cell phone software application, etc.

Out-of-canal assembly **12** is selectively, removably, electrically coupled to in-canal assembly **14** through an electrical cord **30** that enables electrical communication between out-of-canal assembly **12** and in-canal assembly **14**. In-canal assembly **14** is comprised of a microphone **32**, a receiver **34**, and an optional additional receiver **36** housed by, e.g., within, a housing **38**. Microphone **32** is used as a microphone that initially receives sounds that are ultimately heard by a user, while receiver **34** is a speaker that ultimately emits sounds that are heard by a user.

As shown, hearing aid **10** has a secondary microphone **22** that is used for noise cancellation or other audio enhancement purposes, and is located on electrical cord **30**, as will be discussed in connection with FIG. **3** below. In one embodiment, microphone **22** is located separately from housing **24** or housing **38**. Microphone **22** may be used for noise cancellation purposes, for example, or to otherwise modify or adjust the sound that is heard by a user. Microphone **22** can be configured to receive sound for directional purposes, e.g., to focus the sound into a desired polar pattern, resulting in audio enhancement.

FIG. **1**B is an exemplary wiring diagram of the hearing aid **10** of FIG. **1**A. FIG. **1**C represents an alternative hearing aid **11** that is similar to hearing aid **10**. In the embodiment of FIG. **1**B, the optional second microphone **22** is part of or is located adjacent the out of canal assembly **12**.

With reference now to FIGS. **1**A, **1**B, and FIG. **2**, FIG. **2** reflects a data flow process relating to hearing aid **10**, which will now be described in additional detail. As shown at step **50**, if hearing aid **10** is in the on position, a sound is received by the in-canal assembly **14**. The microphone **32**, in the in-canal assembly **14** converts the sound to a signal as shown at step **52**. Audio data is sent to the out-of-canal assembly **12** at step **54** through electrical cord **30**, although a wireless (e.g., Bluetooth) connection may also be established. As shown in step **56**, the central processing unit **16** receives and processes the audio data received from the in-canal assembly **14**.

According to one embodiment, there are audio enhancements, such as additional microphones **22** used to cancel unwanted noise, and other devices and procedures employed to enhance the audio received. As shown at step **58**, if the audio is not enhanced, the audio data processed by the central processing unit **16** is returned to the in-canal assembly **14**, as further shown at step **60** and then is converted to sound by receiver **34** as further reflected in step **62**, after which the sound is received by the listener's eardrum as reflected in step **64**.

In the event that the audio is enhanced by noise cancelling devices, e.g., microphone **22**, the CPU processed audio data is received by an audio program, as shown in step **60**, which may be a user defined program or environment defined program. The sound is then sent to receiver **34** of the in-canal assembly **14** as shown at step **68** and then is converted to sound by receiver **34** as shown at step **70**. As shown at step **72**, the sound is then received by the listener's eardrum.

FIG. **3** is a depiction of hearing aid **10** shown in an exemplary environment. Out-of-canal assembly **12** and in-canal assembly **14** are shown in exemplary housing depictions, although a variety of different housings are available for the components and functions described herein.

Out-of-canal assembly **12** comprises a central processing unit **16**, a battery **20**, and a control device **18**, for example. Battery **20** is in electrical communication with processor **16**. Battery **20** may optionally also be in direct communication with control device **18**, and, when cord **30** is connected, microphone **32**, microphone **22** and receiver **34** of in-canal assembly **14**.

Control device **18** can be a button, a panel of buttons, a rotating volume control, or a variety of other control devices, for example. Optionally, a software application for example on an iphone, or other remote control may be employed as a control device.

As shown, electrical cord **30** connects in-canal assembly **14** to out-of-canal assembly **12**, such that assembly **12** is in electrical communication with assembly **14**. In-canal assembly **14** is comprised of microphone **32**, a receiver **34**, and housing **38** that houses microphone **32** and receiver **34**.

As further shown in FIG. **3**, microphone **32** is mounted within housing **38** so as to be closer to the opening of the ear while receiver **34** of in-canal assembly **14** is positioned within housing **38** so as to be closer to the ear canal and the ear drum. Furthermore, a partition **78** is located between receiver and microphone. This partition **78** enables sound exiting from receiver **34** to be bounced against partition **78** for enhancement of the quality of the reception of the sound to the listener's eardrum. The positioning of the opening of receiver **34** away from the ear drum and toward partition **78** also helps ensure that less moisture from the eardrum is deposited within receiver **34**.

As shown in FIG. **3**, the sound emitting opening of receiver **34** is turned away from the ear canal and toward the microphone **32** such that moisture and wax has a further path to move from the ear drum to be within an opening of receiver **34**. The sound from receiver **34** reflects off partition **78** and then back to the user's eardrum. As shown, the opening of receiver **34** is positioned so as to be oriented toward the partition **78** and away from the ear canal during use of hearing aid **10**. Because of such positioning, reflecting receiver **34** is more resilient to the environmental conditions of the ear, providing protection from wax and oils within the ear, which must travel a further path to infest the opening of the receiver port of receiver **34**. Reflecting receiver **34** thus provides a smoother extended response.

Receiver **34** is a speaker and is an example of a direct reflecting receiver or direct reflecting transducer. The in-canal assembly **14** is at least partially sealed against the acids and other fluids that are inside the ear canal.

In one embodiment, housing **38** comprises a deformable material, such as a tubular metallic or plastic member that is deformable such that it can be placed in the ear canal and formed to the shape of the ear canal in a comfortable manner. The deformable material is, in one embodiment, covered by a custom molded silicone housing, for example. A fitted silicone mold may be mounted around the housing of the in-canal assembly **14** to comfortably fit within the ear of the user. In one embodiment, cord **30** is permanently coupled to in-canal assembly **14** and extends from in-canal assembly **14** to be selectively, removably coupled to out-of-canal assembly **12** as reflected in FIG. **3**. Cord **30** is optionally selectively coupled to in-canal assembly **14**.

Apertures are located in the front and the rear portion of assembly **14** such that sound can be received from the environment into microphone **32** and exit receiver **34** into the ear drum. FIG. **3**A shows a depiction of an embodiment of a rear view of assembly **14**, reflecting that the housing **38** at the rear end (to be pointed toward the ear drum) of assembly **14** may be circular in cross section, while the rear end of the receiver **34** is square, thereby allowing sound to be emitted around the edges of square receiver **34** into the ear drum.

Various options can be employed for providing a housing that surrounds the receiver and/or microphone of the in-canal assembly **14**. For example, as illustrated in FIG. **3**A, in one embodiment, the housing **38** is a tubular member having a circular cross section while the receiver **34** has a square or rectangular cross section such that sound is emitted from the receiver **34** against a partition **78** dividing the receiver **34** from the microphone **32** and is reflected against the internally circular walls surrounding the receiver **34**.

The housing **38** is, one embodiment, circular in cross section and is flexible in a longitudinal direction such that the housing **38** can be bent when inside of the ear canal. In one embodiment there is a flexible connection between the receiver and the microphone such that the in-canal assembly can bend within the ear canal of the user.

The housing **38** of the in-canal assembly **14** may comprise, for example, a flexible metal tube or a flexible plastic tube for example. The partition **78** between the microphone and the receiver can also be comprised of a metallic or plastic material for example.

In one embodiment, as reflected in FIG. **1**A, an additional receiver (see **34***a* in FIG. **1***a*) is positioned side by side next to receiver **34**, such that dual receivers are employed. Furthermore, in one embodiment, particularly as the microphone **32** decreases in size, multiple microphones may be employed in assembly **14**. Thus, microphone **32** can be replaced by multiple microphones in the in-canal assembly **14**. In one embodiment, a second microphone may be employed in the in-canal assembly **14** for directional purposes to enhance noise to signal processing, for example.

As further shown in the embodiment of FIG. **3**, cord **30** has microphone **22** mounted thereon, e.g., integrated into the plug housing, strain gauge, or stem portion of cord **30**, forming a cord assembly **80**. This enables the in-canal assembly **14** and its associated cord assembly **80** (comprising cord **30** and second microphone **22**) to be selectively removed and decoupled from the out-of-canal assembly **12** when desired for warranty service and/or replacement. As a result, both microphones, i.e., **22** and **32** can be sent for replacement or repair simply by disengaging cord **30** from electrical port **82** of assembly **12** without sending the assembly **12** for repair.

Cord assembly **80** thus includes (i) cord **30**, which enables electrical communication between out-of-canal assembly **12** and in-canal assembly **14**, and (ii) microphone **22** mounted on cord **30**, e.g., mounted on or adjacent the a strain gauge and/or plug housing associated with cord **22** such that microphone **22** is selectively mounted adjacent assembly **12** when cord **30** is connected to assembly **12**. For sound enhancement purposes, it is often desirable to position secondary microphone **22** a certain optimal distance from primary microphone **32**. Thus, positioning secondary microphone **22** on cord **30** adjacent assembly **12** also enables microphone **22** to be spaced a desired distance from assembly **14** such that it can be optimally used for noise reduction, directional, or other sound enhancement purposes, (and without taking up space in the in-canal assembly **14** which is inside the ear canal where space is at a premium). This positioning allows microphone **22** to be oriented in a desired location and direction with respect to the other components of device **10**.

In yet another embodiment, cord **30** is selectively coupled to and conveniently removable from the in-canal assembly **14**.

A variety of different connectors for cord **30** may be employed. In one embodiment, the connector is a multi channel connector. In one embodiment, there may be three, four or five or more rings on the connector of cord **30** that fits into port **82**. Port **82** can also be sealed with a rubber "o" ring or grommet such that device **10** is less susceptible to moisture. In one embodiment, cord **30** comprises a stiffened tube such that cord **30** serves as a holding device to help secure hearing aid **10** adjacent the ear of a user. The tube may have sufficient flexibility that it can be selectively adjusted to fit the user's ear.

In yet another embodiment, a second microphone is in the in-canal assembly. The second microphone **22** (whether in the in-canal assembly or on cord **30** as shown in FIG. **3**) can be employed to provide feedback, to provide feedback cancellation, to provide noise cancellation, and to provide various features of modifying the sound that is heard by the user either for the user's comfort, for improving the quality of the sound, or for various aspects of noise cancelation or other noise modification. Second microphone **22** may be used to evaluate and reduce outside noise for example and may perform other functions to control outside noise. Microphone **22** can also be configured to receive sound for directional purposes, e.g., to focus the sound into a desired polar pattern, resulting in audio enhancement.

Assembly **12** and/or cord **30** may be oriented to fit on or near the ear of an individual similar to other behind the ear hearing aid assembly portions. In one embodiment the out-of-canal assembly **12** is connected by the user to the back of the ear similar to other hearing aids that are connected to the back of the ear when worn in a behind the ear format.

In another embodiment, assembly **12** is connected to the ear by piercing the ear, similar to earring piercings, and coupling assembly **12** and/or cord **30** to the ear. This may be useful in a high impact or sports setting to help secure assembly **12**, for example.

In one optional embodiment, as shown in FIG. **3**, assembly **12** further includes a port **90** for receiving an electrical cord from an electronic device such as a cell phone, IPOD, radio, television, or other electronic device that emits audio data, such that a user can hear sound emissions from such devices through hearing aid **10**. Hearing aid **10** can optionally serve as both a hearing aid for receiving sounds in the environment and from people speaking, as well as a listening device, such as a set of headphones for listening to an electronic device such as cell phone, IPOD, radio, etc. In one embodiment, it is possible to switch between a hearing aid mode and a listening device mode. Hearing aid **10** thus serves as an example of a universal sound translator and assisted listening device.

Since the in-canal assembly **14** is removably, electronically coupled to the out-of-canal assembly **12**, the in-canal assembly **14** is readily replaceable. The ability to replace in-canal assembly **14** provides many advantages from a technological, economic and convenient standpoint. The in-canal assembly **14** comprises the components, e.g. the receiver and microphone that are the most commonly subjected to wear, damage, and malfunction due to wax, oils, and fluids associated with the user's ear canal. By separately connecting the in-canal assembly **14** from the out-of-canal assembly **12**, the user is only required to replace the in-canal assembly **14** when any damage occurs.

For example, in one embodiment, a hearing aid **10** is sold with one out-of-canal assembly **14** and with multiple e.g. 2, 3, 4, or 5 in-canal assemblies **14** so that replacement of the in-canal assembly is convenience when damage or wear occurs. This also makes warranty treatment convenient in the event that the in-canal assembly **14** needs to be mailed to an out of town facility for repair or replacement.

FIG. **4** reflects a hearing aid **10**A which is similar to hearing aid **10** except that the in-canal device **14**A of device **10**A does not include a microphone, but rather includes one or more,

e.g., two receivers **34**A. Device **10** includes multiple receivers **34***a* in the in-canal component with a tuned port.

Furthermore, out-of-canal assembly **12**A includes a port **90***a* for receiving an electrical cord from an electronic device such as a cell phone, MP-3 player, IPOD, radio, television, or other electronic device that emits audio data. Hearing aid **10**A is thus not typically considered to be known as a hearing aid, but may act more as a headphone or headphone enhancement device that includes device controls e.g. volume control **18**A for controlling the amount and/or quality of sound received from electronic device **92**. Optionally, the controls may be remote controls, e.g., through a software application on a mobile phone, for example. A wireless, e.g., Bluetooth connection to a an electronic device **92** is used in another embodiment.

In another embodiment, a microphone is associated with device **10***a*, e.g., similar to the positioning of microphone **22** on cord **30** for noise cancellation or other audio enhancement purposes, such as noise modification, for example. Device **12***a* may employ processing and noise reduction and shaping of the sound, for example, to compensate for hearing loss. By operating control device **18***a* or a remote control device, the user can employ noise reduction and/or listen to music, for example. Optionally, the user can employ a program that would process competing noise and engage in noise cancellation and still allow the user to hear speech or perform noise reduction and allow the user to hear music. The user can listen to music or audio for example and either hear the surrounding noise or close it out or mute it or set it to whatever level is desired.

Microphone **22** and/or a similar microphone may be a directional or an omni-directional microphone system, for example, to generate enhanced noise to signal processing. One or more microphones may also be mounted on housing **24** of out-of canal assembly **12**, e.g., for directional and audio-enhancement purposes.

FIGS. **5-6** depict additional examples of hearing aids of the present invention. For example, one hearing aid may comprise an in-canal assembly **100** and out-of-canal assembly **102** or an out-of-canal assembly **104** which includes multiple out-of-canal devices e.g., a processor, a battery, a microphone, or a combined processor/battery and one or more microphones, for example. FIG. **6** is a depiction of an alternate option for a hearing aid of the present invention, wherein components are placed behind the ear, in the concha, or in the helix, for example.

With reference now to FIGS. **7** and **8**, an in-canal assembly **100** is comprised of a receiver **110**, a microphone **112** and a sub-housing **114** that houses receiver **110** and microphone **112**. Sub-Housing **114** may be further covered by a silicone housing **116**, for example, as reflected in the functional view in broken lines **116**. Assembly **110** may be used as an example of in-canal assembly **14** of FIGS. **1-3**, for example.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A hearing aid that is subject to convenient repair, the hearing aid comprising:

an out-of-canal assembly configured to be worn outside the ear canal of a user, the out-of-canal assembly comprising: (i) a power source; and (ii) a processor,

an in-canal assembly configured to be worn in the ear canal of a user, the in-canal assembly comprising (i) a microphone; and (ii) a receiver,

wherein the out-of-canal assembly is in electrical communication with the in-canal assembly, such that sound received by the in-canal assembly is processed by the out-of-canal assembly and transmitted to the user, wherein the receiver of the in-canal assembly has an opening, from which sound is emitted, that is positioned so as to be oriented away from the ear drum during use such that the receiver is resilient against environmental conditions of the ear, and

wherein the microphone and the receiver of the in-canal assembly are separated by a partition.

2. A hearing aid as recited in claim **1**, wherein the out-of-canal assembly is selectively coupled to the in-canal assembly and is conveniently, selectively decoupled from the in-canal assembly for convenient replacement or repair.

3. A hearing aid as recited in claim **1**, wherein an electrical cord couples the out-of-canal assembly in electrical communication with the in-canal assembly.

4. A hearing aid as recited in claim **3**, wherein a second microphone is mounted on the electrical cord so as to be positioned adjacent the out of canal assembly.

5. A hearing aid as recited in claim **1**, wherein the opening of the receiver, from which sound is emitted, is positioned so as to be oriented toward the partition and away from the ear drum of a user during use, thereby protecting the receiver from environmental conditions of the ear.

6. A hearing aid that is subject to convenient repair, the hearing aid comprising:

an out-of-canal assembly configured to be worn outside the ear canal of a user, the out-of-canal assembly comprising: (i) a power source; and (ii) a processor,

an in-canal assembly configured to be worn in the ear canal of a user, the in-canal assembly comprising (i) a microphone; and (ii) a receiver, and

an electrical cord coupling the out-of-canal assembly in electrical communication with the in-canal assembly, such that sound received by the in-canal assembly is processed by the out-of-canal assembly and transmitted to the user, wherein the microphone and the receiver of the in-canal assembly are separated by a partition and wherein an opening of the receiver, from which sound is emitted, is positioned so as to be oriented toward the partition and away from the ear drum of a user during use, thereby protecting the receiver from environmental conditions of the ear.

7. A hearing aid as recited in claim **6**, wherein the out-of-canal assembly is selectively coupled to the in-canal assembly and is conveniently, selectively decoupled from the in-canal assembly for convenient replacement or repair.

8. A hearing aid as recited in claim **6**, further comprising a second microphone mounted on the electrical cord.

9. A hearing aid as recited in claim **8**, wherein the second microphone is mounted on the electrical cord so as to be positioned adjacent the out of canal assembly.

10. A hearing aid that is subject to convenient repair, the hearing aid comprising:

an out-of-canal assembly configured to be worn outside the ear canal of a user, the out-of-canal assembly comprising: (i) a power source; and (ii) a processor;

an in-canal assembly configured to be worn in the ear canal of a user, the in-canal assembly comprising: (i) a microphone; and (ii) a receiver, wherein

the out-of-canal assembly is in electrical communication with the in-canal assembly, such that sound received by

the in-canal assembly is processed by the out-of-canal assembly and transmitted to the user, wherein the microphone and the receiver of the in-canal assembly are separated by a partition, and wherein an opening of the receiver, from which sound is emitted, is positioned so as to be oriented toward the partition and away from the ear drum of a user during use, thereby protecting the receiver from environmental conditions of the ear.

11. A hearing aid as recited in claim **10**, wherein the out-of-canal assembly is selectively coupled to the in-canal assembly and is conveniently, selectively decoupled from the in-canal assembly for convenient replacement or repair.

12. A hearing aid as recited in claim **10**, wherein the out of canal assembly is coupled to the in canal assembly by an electrical cord, such that the out of canal assembly is in electrical communication with the in canal assembly.

13. A hearing aid as recited in claim **10**, wherein the out of canal assembly is selectively coupled to the in canal assembly by an electrical cord, such that the out of canal assembly is selectively in electrical communication with the in canal assembly.

14. A hearing aid as recited in claim **13**, further comprising a second microphone mounted on the electrical cord.

15. A hearing aid as recited in claim **14**, wherein the second microphone is located on the electrical cord adjacent a plug of the electrical cord so as to be adjacent the out of canal assembly.

16. A hearing aid as recited in claim **14**, wherein the microphone of the in canal assembly is configured to receive sound to be sent to the eardrum of a user.

17. A hearing aid as recited in claim **16**, wherein the second microphone is configured to receive sound for directional purposes.

18. A hearing aid as recited in claim **16**, wherein the second microphone is configured to receive sound to be used in audio enhancement.

19. A hearing aid as recited in claim **16**, wherein the second microphone is configured to be used in noise cancellation.

20. A hearing aid, as recited in claim **10**, wherein the out-of-canal assembly comprises a control device for controlling the hearing aid.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,332,356 B2
APPLICATION NO. : 13/875529
DATED : May 3, 2016
INVENTOR(S) : Finlay

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Specification

Column 3
Line 10, change "receiver 36" to --receiver 34A--

Column 4
Line 20, change "between receiver" to --between the receiver--

Column 5
Line 10, change "housing 38 is, one embodiment" to --housing 38 is, in one embodiment--
Line 45, change "adjacent the a strain" to --adjacent the strain--

Column 6
Line 50, change "convenient" to --convenience--
Line 61, change "convenience" to --convenient--

Column 7
Line 14, change "to a an electronic" to --to an electronic--

Signed and Sealed this
Sixth Day of December, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office